CLAIMS

What is claimed is:

1. A method for collecting and processing data in a sensor network, comprising:

coupling a plurality of network elements including at least one node among an environment and at least one client computer;

collecting data from the environment;

remotely controlling at least one function of the at least one node;

providing node information including node resource costs and message priority from the at least one node to the plurality of network elements; and

distributing processing of the collected data among the plurality of network elements in response to the node information.

2. The method of claim 1, wherein the at least one node includes sensing, processing, communications, and storage devices supporting a plurality of processing and protocol layers.

3. The method of claim 1, further comprising supporting at least one communication mode selected from a group consisting of wireless communications, wired communications, and hybrid wired and wireless communications.

4. The method of claim 1, further comprising coupling the at least one node to the at least one client computer through the plurality of network elements, wherein the plurality of network elements includes at least one gateway, at least one server, and at least one network.

5. The method of claim 4, further comprising performing at least one function using the at least one gateway, wherein the at least one function is selected from a group consisting of protocol translation, sensor network management, management of transmissions from a remote user, and interfacing

with at least one communication physical layer including wired local area networks, packet radio, microwave, optical, wireline telephony, cellular telephony, and satellite telephony.

6. The method of claim 4, wherein the at least one network comprises wired networks, wireless networks, and hybrid wired and wireless networks, wherein the at least one network comprises at least one network selected from a group comprising the Internet, local area networks, wide area networks, metropolitan area networks, and information service stations.

7. The method of claim 1, further comprising internetworking among the plurality of network elements to provide remote accessibility using World Wide Web-based tools for data, code, management, and security functions, wherein data includes signals or images, wherein code includes signal processing, decision support, and database elements, and wherein management includes operation of the at least one node and the sensor network.

8. The method of claim 4, wherein the plurality of network elements further includes at least one device selected from a group consisting of repeaters and interrogators.

9. The method of claim 1, further comprising coupling at least one local user to the at least one node.

10. The method of claim 1, further comprising establishing at least one redundant information pathway among the plurality of network elements.

11. The method of claim 1, wherein the plurality of network elements comprise a plurality of network element sets, wherein the plurality of network element sets are layered.

12. The method of claim 1, wherein the at least one node comprises a plurality of node types, wherein the plurality of node types includes at least one node of a first type and at least one node of a second type, wherein a first

network having a first node density is assembled using the at least one node of a first type, wherein a second network having a second node density is assembled using the at least one node of a second type, wherein the second network is overlayed onto the first network.

13. The method of claim 1, further comprising predistributing code and data anticipated for future use through the sensor network using low priority messages, wherein the code and the data are downloadable from at least one location selected from a group consisting of storage devices of the plurality of network elements, and storage devices outside the sensor network.

14. The method of claim 1, further comprising automatically organizing the plurality of network elements in response to the node information, wherein the organizing comprises automatically controlling data transfer, processing, and storage within the sensor network.

15. The method of claim 1, further comprising supporting a plurality of levels of synchronization among different subsets of the plurality of network elements, wherein a first level of synchronization is supported among a first subset of the plurality of network elements, wherein a second level of synchronization is supported among a second subset of the plurality of network elements.

16. The method of claim 1, further comprising controlling data processing using at least one processing hierarchy, the at least one processing hierarchy controlling at least one event selected from a group consisting of data classifications, data transfers, data queuing, data combining, processing locations, communications among the plurality of network elements.

17. The method of claim 1, further comprising transferring data using message packets, wherein the message packets are aggregated into compact forms in the at least one node using message aggregation protocols, wherein the message aggregation protocols are adaptive to at least one feature selected from

a group consisting of data type, node density, message priority, and available energy.

18. The method of claim 17, wherein the message packets include decoy message packets, wherein information to be transferred is impressed on random message packets to provide communication privacy.

19. The method of claim 1, wherein the at least one function includes data acquisition, data processing, communication, data routing, data security, programming, and node operation.

20. The method of claim 1, further comprising coupling at least one preprocessor to at least one processor and a plurality of application programming interfaces (APIs) in the at least one node, wherein the plurality of APIs are coupled to control at least one device selected from a group consisting of sensors, actuators, communications devices, signal processors, information storage devices, node controllers, and power supply devices, wherein the plurality of APIs support remote reprogramming and control of the at least one device.

21. The method of claim 20, wherein the plurality of APIs are layered.

22. The method of claim 20, further comprising enabling distributed resource management with the plurality of APIs by providing network resource information and message priority information to the plurality of network elements.

23. The method of claim 22, wherein information transfer among the plurality of network elements is controlled using a synchronism hierarchy established in response to the resource information and message priority information.

24. The method of claim 20, wherein the at least one preprocessor performs at least one function selected from a group consisting of data acquisition, alert

functions, and controlling at least one operating state of the at least one node, wherein the at least one processor performs at least one function selected from a group consisting of signal identification, database management, adaptation, reconfiguration, and security.

25. The method of claim 1, further comprising controlling data processing and transmission in the at least one node in response to a decision probability of a detected event.

26. The method of claim 1, further comprising coupling the at least one node to at least one sensor selected from a group consisting of seismic, acoustic, infrared, thermal, force, vibration, pressure, humidity, current, voltage, magnetic, biological, chemical, acceleration, and visible light sensors.

27. The method of claim 26, further comprising:

processing data gathered by the at least one sensor;

generating a predetermined identifying code representing the processed data; and

propagating the identifying code through the sensor network, wherein a high priority message containing information regarding a high priority event is represented by a high priority message code, and wherein receipt of the high priority message code by the at least one node invokes a priority protocol that causes message packets to be broadcast to nodes adjacent to a path that will inhibit messaging from nodes not engaged in conveying the information regarding the high priority event.

28. The method of claim 1, further comprising self-assembling the plurality of network elements, wherein search and acquisition modes of the at least one node search for participating ones of the plurality of network elements, wherein a determination is made whether each of the participating ones of the plurality of network elements are permitted to join the sensor network using a message hierarchy, wherein the sensor network is surveyed at random intervals for new nodes and missing nodes.

29. The method of claim 1, further comprising self-assembling the plurality of network elements into a multi-cluster network.

30. The method of claim 29, wherein a start node is selected as a base node, wherein the base node communicates an assembly packet throughout the sensor network, wherein information of the assembly packet alternates with each successive communication between directing a node to become a base node of a particular cluster number and directing a node to become a remote node of a particular cluster number, wherein the particular cluster number is incrementally changed with each successive communication of the assembly packet.

31. The method of claim 29, wherein at least one start node is selected as at least one base node, wherein the at least one base node communicates an assembly packet throughout the sensor network, wherein information of the assembly packet alternates with each successive communication between directing at least one node to become at least one base node of a particular cluster number and directing at least one other node to become at least one remote node of a particular cluster number, wherein the particular cluster number is incrementally changed with each successive communication of the assembly packet.

32. The method of claim 29, further comprising establishing synchronism among the plurality of network elements using the assembly packets.

33. The method of claim 1, further comprising managing the sensor network as a distributed and active database using a distributed resource management protocol, wherein the plurality of network elements are reused among different applications, wherein the network elements are used in multiple classes of applications.

34. The method of claim 1, wherein the plurality of network elements further comprises at least one database including at least one storage device

selected from a group consisting of storage devices coupled to at least one of the plurality of network elements and storage devices of the at least one node.

35. The method of claim 34, wherein the at least one database comprises data-driven alerting methods that recognize conditions on user-defined data relationships including coincidence in signal arrival, node power status, and network communication status.

36. The method of claim 34, further comprising implementing the at least one database in small foot print databases at a level of the at least one node and in standard query language (SQL) database systems at a level of at least one server.

37. The method of claim 1, further comprising:

collecting data by the at least one node;

performing at least one operation on the collected data in response to parameters established by a user, the at least one operation selected from a group consisting of energy detection, routing, processing, storing, and fusing.

38. The method of claim 37, wherein the routing, processing, storing, and fusing are performed in response to at least one result of the energy detection.

39. The method of claim 37, wherein the routing comprises selecting at least one data type for routing, selecting at least one of the plurality of network elements to which to route the selected data, selecting at least one route to the selected at least one of the plurality of network elements, and routing the selected at least one data type to the selected at least one of the plurality of network elements.

40. The method of claim 37, wherein the processing comprises selecting at least one data type for processing, selecting at least one processing type, selecting at least one of the plurality of network elements to perform the selected at least one processing type, and transferring the selected at least one

data type to the selected at least one of the plurality of network elements using at least one route through the sensor network.

41. The method of claim 40, wherein selecting at least one processing type comprises determining at least one probability associated with a detected event and selecting at least one processing type in response to the at least one probability.

42. The method of claim 40, further comprising aggregating data processed in a plurality of nodes for further processing by other nodes.

43. The method of claim 40, further comprising aggregating data processed by the at least one node for reporting to at least one user.

44. The method of claim 37, wherein the storing comprises selecting at least one data type for storage, selecting at least one storage type, selecting at least one of the plurality of network elements to perform the selected at least one storage type, and transferring the selected at least one data type to the selected at least one of the plurality of network elements using at least one route through the sensor network.

45. The method of claim 37, wherein the fusing comprises transmitting at least one query request from a first node to at least one other node, wherein the first node collects data from the at least one other node in response to the at least one query request and processes the collected data.

46. The method of claim 1, wherein the at least one node comprises a plurality of nodes with each of the plurality of nodes including at least one bi-static sensor and a generator for producing at least one energy beam that is radiated from the plurality of nodes, wherein the at least one energy beam comprises a combined probe beam and signal code for beam intensity control and propagation measurement, wherein the at least one energy beam is modulated in time to provide an identifying code corresponding to a source

node, wherein the at least one energy beam is a type selected from a group comprising infrared, visible, acoustic, and microwave beams.

47. The method of claim 1, further comprising determining a position of the at least one node.

48. The method of claim 1, further comprising transferring software among the plurality of network elements, wherein the software transfer is remotely controllable.

49. The method of claim 1, further comprising protecting communications using at least one public key security protocol.

50. The method of claim 1, further comprising providing location and time information to the plurality of network elements using a Global Positioning System (GPS) device.

51. The method of claim 1, further comprising communicating among the plurality of network elements using at least one communication modem.

52. The method of claim 1, further comprising communicating among the plurality of network elements using multihop communications.

53. The method of claim 1, wherein the environment is at least one environment selected from a group consisting of electronic equipment, mechanical equipment, electro-mechanical equipment, a facility, a structure, a material, a transportation system, a vehicle, an outdoor area, an indoor area, a biological system, a person, and an animal.

54. The method of claim 1, further comprising:

providing a plurality of software modules;

supporting couplings among the plurality of software modules using a plurality of interfaces;

reusing the plurality of interfaces among the plurality of software modules by changing at least one inter-module coupling; and

dynamically configuring the plurality of software modules at run-time.

55. A method for providing a sensor network, comprising:

coupling a plurality of network elements including at least one node among at least one environment and at least one client computer using at least one coupling with the Internet;

remotely controlling functions of the plurality of network elements;

providing node information including node resource cost and message priority to the plurality of network elements in response to at least one parameter of at least one signal received from the at least one environment; and

controlling at least one function of the plurality of network elements in response to the node information.

56. The method of claim 55, wherein the at least one parameter is remotely programmed using the at least one client computer.

57. The method of claim 55, wherein the at least one function includes at least one function selected from a group consisting of programming, configuring, assembling the plurality of network elements, distributing processing among the plurality of network elements, establishing communication paths among the plurality of network elements, selecting at least one mode of communication among the plurality of network elements, distributing data among the plurality of network elements, storing data, organizing at least one subnetwork among the plurality of network elements, controlling synchronization among the plurality of network elements, assembling data products, and reporting.

58. A method of operating a sensor network, comprising:

coupling a plurality of network elements including at least one node among an environment and at least one client computer with at least one Internet coupling;

collecting data from the environment; and

remotely programming and controlling at least one function of the at least one node via internetworking among the plurality of network elements.

59. The method of claim 58, further comprising:

providing node information including node resource information and message priority to the plurality of network elements;

distributing processing of the collected data to the plurality of network elements in response to the node information.

60. A computer readable medium containing executable instructions which, when executed in a processing system, cause the processing system to collect and process data in a sensor network by:

coupling a plurality of network elements including at least one node among an environment and at least one client computer;

collecting data from the environment;

remotely controlling at least one function of the at least one node;

providing node information including node resource costs and message priority from the at least one node to the plurality of network elements; and

distributing processing of the collected data among the plurality of network elements in response to the node information.

61. An electromagnetic medium containing executable instructions which, when executed in a processing system, cause the processing system to collect and process data in a sensor network by:

coupling a plurality of network elements including at least one node among an environment and at least one client computer;

collecting data from the environment;

remotely controlling at least one function of the at least one node;

providing node information including node resource costs and message priority from the at least one node to the plurality of network elements; and

distributing processing of the collected data among the plurality of network elements in response to the node information.

62. A computer readable medium containing executable instructions which, when executed in a processing system, cause the processing system to provide a sensor network by:

coupling a plurality of network elements including at least one node among at least one environment and at least one client computer using at least one coupling with the Internet;

remotely controlling functions of the plurality of network elements;

providing node information including node resource cost and message priority to the plurality of network elements in response to at least one parameter of at least one signal received from the at least one environment; and

controlling at least one function of the plurality of network elements in response to the node information.

63. An electromagnetic medium containing executable instructions which, when executed in a processing system, cause the processing system to provide a sensor network by:

coupling a plurality of network elements including at least one node among at least one environment and at least one client computer using at least one coupling with the Internet;

remotely controlling functions of the plurality of network elements;

providing node information including node resource cost and message priority to the plurality of network elements in response to at least one parameter of at least one signal received from the at least one environment; and

controlling at least one function of the plurality of network elements in response to the node information.